

# Modeling And Simulation – A New Role for the Operational Tester

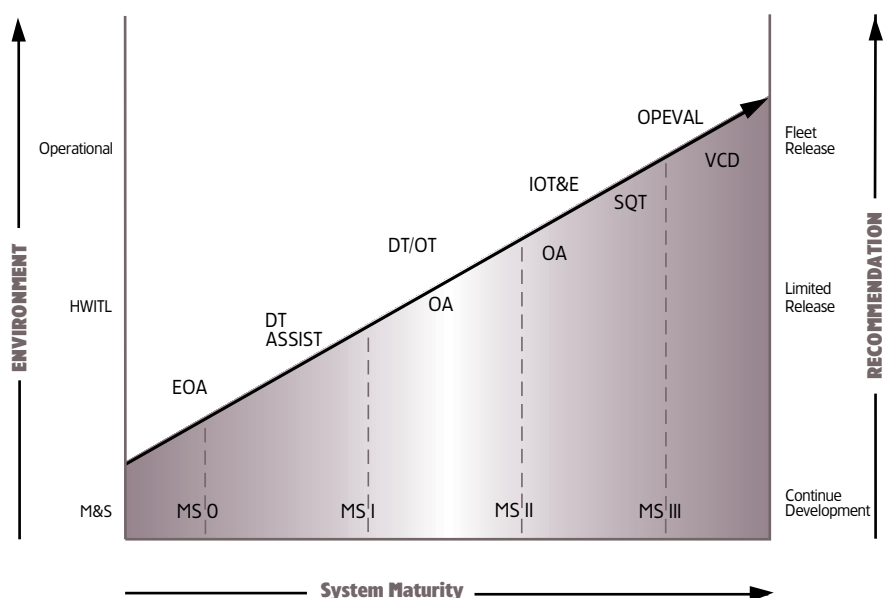
## Every Ideal Test is Tempered with Constraints

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**T**he traditional role of the independent operational tester has been as the fleet users' representative in the acquisition process. It is the operational tester's responsibility to independently determine the operational effectiveness and operational suitability of a new, improved, or upgraded system prior to introduction to the fleet. This determination is achieved by testing a production representative system, in the operational environment, against the expected threat, and using fleet representative operators and maintainers. That has been the mission of Commander, Operational Test and Evaluation Force (COMOPTEVFOR) for over 50 years.

### Levels of OT&E

There are many different levels of operational test and evaluation (OT&E) conducted by COMOPTEVFOR, including developmental assist (DT Assist), early operational assessment (EOA), operational assessment (OA), initial operational test (IOT), software qualification testing (SQT), operational evaluation (OPEVAL), verification of correction of deficiency (VCD), and follow-on operational testing and evaluation (FOT&E), all of which, with the exception of DT Assist, will result in a recommendation from COMOPTEVFOR on fleet utilization or continued development. Each of these levels of operational testing (OT) involve varying levels of operational realism/fidelity, and therefore will result in varying levels of conclu-



### Fleet Utilization/Release Recommendation

sions with regard to operational effectiveness and suitability as well as a fleet release recommendation. The simple rule of thumb is: The level of confidence in projected system performance during actual fleet operations is directly proportional to the fidelity of the scenario in which the test is conducted with regard to the operating environment, including both the physical environment and system maturity. The chart graphically depicts this rule of thumb.

There are two fundamental considerations for the operational tester that apply to both real-world OT and *modeling and simulation*.

Fidelity to operational environment. How representative to the operational environment is the scenario under which the data are collected? Given the constraints placed upon even real-world OT, actual test scenarios are only "representative" of how the system will be employed. The level of fidelity of a model or simulation can be compared to the level of fidelity of any real-world operational test. In real-world OT, it is not possible to conduct a test in actual combat conditions; therefore, some level of replication of actual combat is planned with as many of the variables and limitations identified as possible. This process is accepted because we test to an accept-

able level of confidence, with the understanding that every ideal test is tempered with constraints such as funding, resource availability, technology, etc. We continually leverage all data sources to ensure the maximum use of available resources. All of this brings us to an operational test that is less than the ideal, and this is accepted and rational. Since OT is representative of fleet operations, there are always tradeoffs and resulting limitations to the scope of testing. It is anticipated that *modeling and simulation* will be an effective tool in examining those areas that have, in the past, constrained OT&E.

**System maturity.** Where in the development/procurement cycle is the system? Early on in the acquisition/development cycle, it is not expected that systems will be able to fully meet all of their operational requirements. Systems, as well as supporting *modeling and simulation*, are expected to mature over time, in parallel, with each successive operational test building upon the information collected previously.

It is anticipated that models and simulations used for system design will evolve and support those for initial testing, and so on. COMOPTEVFOR, working in parallel with the system developers and *modeling and simulation* proponents, will gain additional insight into how the proposed system is planned to meet its operational requirements.

## **Rational Interpretation and Implementation**

There is no argument that *modeling and simulation* has the potential to be a highly effective and efficient tool in support of the entire DoD acquisition process and especially OT&E. It is the rational implementation of that tool which is required. The specific limiting uses of *modeling and simulation* are delineated in DoDD 5000.2-R, and their use is recommended for all Major Defense Acquisition Programs (MDAP) and Major Automated Information Systems (MAIS) programs. Common sense dictates that this approach also applies to other than

MDAPs and MAIS; however, it is the interpretation and implementation of this directive where common sense plays the biggest role. The extent to which *modeling and simulation* can be used to supplement OT is generally a negotiation between the model proponent and the operational tester, and this is where the new role for the operational tester is created.

In the traditional role, the operational tester did not set requirements or thresholds for the system to be tested and evaluated, and this remains the role for systems under test. In the case of *modeling and simulation*, where users of the model/simulator are the operational testers, it is they who must aid in the definition of the performance output requirements of the model/simulation. It is the operational testers who must be satisfied with the level of validation and fidelity, as the users, to recommend accreditation of the model/simulation based on that level of satisfaction.

The directives and instructions recommending consideration of the use of *modeling and simulation* do not prescribe specifically where *modeling and simulation* should be employed. They do, however, specifically state that *modeling and simulation* cannot be used exclusively to support beyond low rate initial production decisions. Directives and instructions also do not specifically prescribe any limiting amount of developmental data that can be used to supplement OT. The decision as to the amount of "other" data (i.e., data not directly collected from an independent operational test) that are used to evaluate a system by the operational tester is the decision of the operational tester, and this includes the amount of *modeling and simulation* used to supplement operational data.

## **Use of Modeling and Simulation in T&E and OT**

In support of the Navy and DoD Vision for the use of *modeling and simulation* in T&E, COMOPTEVFOR will continue to work to implement the advancements and improvements of

the T&E process by applying *modeling and simulation* technology to –

- improve product quality and functionality;
- reduce technical risk and program cost;
- enhance performance assessments; and
- make comprehensive T&E more affordable.

To accomplish this, COMOPTEVFOR will endeavor to make significant contributions to acquisition streamlining by –

- providing test environments that can reduce acquisition life-cycle costs and time with no increase in acceptable risk; and
- enabling the developmental and operational testers to participate in the model-test-model process and integrated product team without compromising the operational tester's independence.

Specifically, one method of accomplishing this is by leveraging off of the extensive technical capabilities/knowledge within program offices to assist in OT. The use of program office resources in the understanding of system design and implementation of operational requirements will in no way compromise the independence of the operational tester.

COMOPTEVFOR has, over the past year, been highly active in exploring more efficient ways in which to use modeling and simulation to supplement OT. The majority of the endeavors to date have been in accrediting hardware/human-in-the-loop laboratories and engineering facilities. Accreditation by COMOPTEVFOR is application and use-specific. In general, verification and validation (V&V) data will be reusable to support accreditation decisions for other uses of a model or simulation. However, V&V data are also gathered against specific

rather than general requirements, and may need to be amplified for a particular application. The information needed for accreditation, and the underlying V&V processes and procedures, will vary depending upon the nature and scope of the simulation. In particular, verification, validation, and accreditation (VV&A) of federations and their associated federates is a challenge that still needs to be addressed. The VV&A agents must begin early in the development process to identify the VV&A requirements for federation models.

### **Involve Operational Testers Early**

As Navy operational testers are not software or systems engineers but rather are operators with widely varying degrees of technical education, it is imperative that the operational testers be involved early and are sufficiently educated to understand the basic principles and uses of *modeling and simulation*. To this end, it was necessary for COMOPTEVFOR to develop a list of fundamental questions for the operational test director (OTD). The answers to these questions will assist the OTD in establishing a baseline knowledge level with regard to each modeling/simulation development and utilization.

**Q** What is the reason for the initial development of the model, and what is its similarity to the current application? Is there a requirements document for the model and a software design specification for the initial implementation and for any modifications?

**Q** What is the developer's reputation, Software Engineering Institute rating, and model development experience? Can the developer provide metrics on software maturity, complexity, requirements traceability, design stability, and depth and breadth of testing?

**Q** What are the hardware, software, personnel, data, and security requirements associated with using the model? What is the

*schedule for model development and model V&V activities?*

**Q** What is the configuration management (CM) status of the model and its associated databases? Does the CM process have these four characteristics: (1) a well-defined baseline; (2) standard baseline test cases and data sets; (3) well-defined, coordinated, and supported testing program; and (4) current, thorough documentation?

**Q** What V&V has been accomplished, or is planned, to establish model credibility?

**Q** What modeling and simulation documentation is available (types of documentation, detail, accuracy, and currency)?

**Q** What are the known limitations or problems with the model? (A good configuration management system has such a list readily available.)

Operational Testers do not "test" or verify models or simulations. They are, however, closely involved in the validation process. The Draft COMOPTEVFORINST 5000.X establishes procedures on the use of models to support OT&E and describes the information necessary for accreditation by COMOPTEVFOR. It is the model proponent's responsibility, in conjunction with COMOPTEVFOR, to —

- develop plans to use *modeling and simulation* in OT, which includes a description of the system, test objectives, *modeling and simulation* objectives, and a test schedule;
- develop V&V to support accreditation for the application; and
- provide a V&V plan, V&V reports, and other support documentation, such as model user guides, analyst notebooks, configuration management plans, software development policy and procedures, and software process review reports.

The accreditation package contains at least the minimum documentation required by DoD 5000.59P and Draft SECNAVINST 5200.XX.

### **Conclusions**

As a tool to supplement for limited assets, it is COMOPTEVFOR policy that the *modeling and simulation* will not replace actual operational assets. *Modeling and simulation* is a tool to more effectively and efficiently employ the limited assets available. *Modeling and simulation* should not be used to extrapolate system performance. The Navy's Draft Test and Evaluation Modeling and Simulation Master Plan includes the documentation requirements, with formats, for the use of *modeling and simulation* in OT. The accreditation plan format, accreditation report format, and verification and validation report format are suggested formats and can be tailored to each application.

While OT must remain "operational," *modeling and simulation* can be used very successfully in test planning, rehearsals, training, post-test analysis, and in limited cases, the test itself. Specific guidance on when *modeling and simulation* can be successfully applied cannot be a cookbook approach. Each program must examine the testing areas that could be more effectively executed using *modeling and simulation*. In some cases, the use of *modeling and simulation* may be more expensive than traditional testing, but yield results that would be impossible to obtain using traditional testing. In all cases, the decision makers and the operational testers must assess the value added by *modeling and simulation* and determine the most cost-effective testing plan.

Operational testers must continue to participate in the *modeling and simulation* initiative that will form the basis for future use of emerging technologies to ensure OT&E specific issues are incorporated. Additionally, an aggressive effort must be made to identify and use the full capability of *modeling and simulation* within OT&E.